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BEFORE THE
POSTAL REGULATORY COMMISSION

Periodic Reporting **(UPS Proposals One, Two, and Three)**	: : :	**Docket No. RM2016-2**

UNITED PARCEL SERVICE, INC.'S RESPONSE TO CHAIRMAN'S INFORMATION REQUEST NO. 4

United Parcel Service, Inc. ("UPS") respectfully submits the following response to Chairman's Information Request No. 4 (Dec. 17, 2015).

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1. **Please confirm that UPS allocates inframarginal costs to its various products.**

   a. **If confirmed, please describe the applied method for calculating and allocating these costs and identify and explain any differences between this method and the method proposed in Proposal One.**

Confirmed. UPS attributes its "inframarginal" costs, along with its other costs, to its various individual products and services. In fact, because UPS attributes *all* of its variable costs to products, it has no need to break out a separate category of "inframarginal" costs, as the Postal Service does.

UPS attributes all of its variable costs to its products in order to ensure that each of its product lines is profitable. It is a basic economic fact that if a company with economies of scale were to price its products to recover only the *marginal* cost of the last unit, it would fail to earn a profit and, over time, would likely go out of business.[1]

To avoid this fate, UPS utilizes Activity Based Costing, a well accepted costing methodology that identifies the activities in a company that generate costs and attributes the cost of each activity to the company's various products and services according to the actual use of that activity by each. UPS's approach can be broken into several steps:

First, UPS identifies the various activities of the enterprise that generate costs. Examples of such activities include the sorting of products for efficient delivery and the pickup of products from UPS customers. Next, UPS identifies the primary cost drivers associated with each activity. For example, the main cost driver associated with local

[1] *See, e.g.,* Dennis W. Carlton & Jeffrey M. Perloff, MODERN INDUSTRIAL ORGANIZATION at 113 (4th ed. 2004) (explaining that it is unsustainable for a regulated utility to price only at marginal cost).

sorting is weight. Products that weigh more generate a greater amount of cost per piece in the sorting process than those products that weigh less. UPS then calculates the average cost per cost driver unit associated with each of these activities by dividing the total activity cost by the number of cost driver units associated with the activity.

Finally, UPS attributes costs to its various product lines based on the individual proportions of the cost drivers associated with each of the product lines. UPS then relies upon these cost factors when setting prices for its individual products in order to make sure each product is covering *all* the costs (and not just the marginal cost) caused by the product within the scope of an activity.

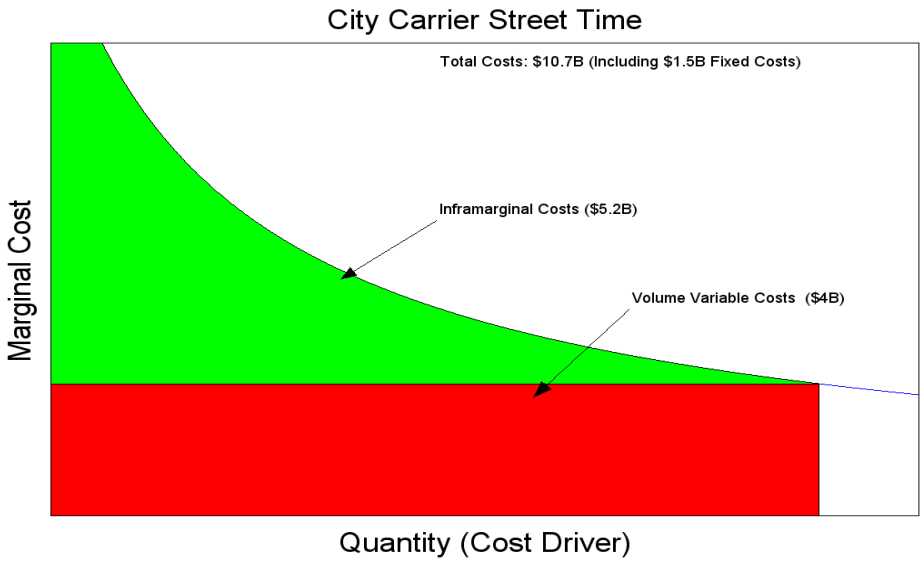
UPS's current practices and UPS Proposal One are, therefore, computationally and economically equivalent with respect to the treatment of variable costs. Both reliably assign all variable costs to products in accordance with the cost driver volumes for which those products are responsible.

The Postal Service has in place machinery that would allow it to do this as well. Like UPS, the Postal Service breaks its costs down into various activities (the Postal Service's cost components). Like UPS, the Postal Service identifies cost drivers for each category of its activities, such as the number of pieces handled or the number of cubic feet occupied. Like UPS, the Postal Service uses those cost drivers to measure the costs associated with its products.

But after putting in place the machinery that would allow the Postal Service to attribute all variable costs (measured in cost-driver units) to each of its products, the Postal Service stops short of doing so. Instead, with the exception of a trivial amount of product-specific fixed costs, it attributes only its *marginal* costs to products (what it calls

"volume variable" costs), while failing to attribute any of the remaining variable costs (known as "inframarginal" costs) to those products.

This difference can be seen in Figure 1-3 from UPS Proposal One.



In a similar cost pool, UPS would attribute all of the costs under the cost curve to its products — both the green and red areas under the curve. Since these are all variable costs, they can and should be attributed to the products that drive them.

The Postal Service, by contrast, attributes only the red area under the curve to its products. By doing so, the Postal Service fails to attribute large swaths of variable costs to its products, even though it has the machinery in place to do so – *i.e.*, its system of using the distribution keys to attribute cost drivers to products. Because of this gaping hole in its cost attribution practices, the Postal Service is unable to ensure that each of its individual competitive products is profitable.

b. **If not confirmed please:**
   i. **Explain why UPS does not allocate inframarginal costs to its products.**
   ii. **Explain why it is appropriate for the Postal Service to allocate infra-marginal costs to its products.**

N/A.

2. **On page 22 of The Neels Report, it states: "The Shapley [v]alue…provides a solution to the problem of how to attribute cost responsibility…" Please give any examples of when and how UPS has used Shapley values for allocation of costs to its various products. If there are no such examples, please indicate if UPS is planning to apply Shapley value for attributing costs.**

At the outset, UPS wishes to be clear that UPS Proposal One does not ask the Postal Service to engage in any wholesale replacement of its existing cost estimation and attribution procedures with methods that come directly out of Dr. Shapley and Dr. Roth's Nobel-prize winning work. Instead, UPS and Dr. Neels have discussed this work because it provides conceptual insights that support the changes proposed in UPS Proposal One.[2]

These proposed changes draw upon *existing* Postal Service costing procedures, while making two necessary adjustments: First, the Postal Service should not limit the costs it attributes to individual competitive products to marginal (or so-called "volume variable") costs, but instead should utilize the machinery already in place to attribute *all* variable costs to products. Second, the existing incremental cost test applied to competitive products as a group should be supplemented with an order-neutral test that does not rely on the assumption that market-dominant products come first on the cost curve (and thus bear the more expensive variable costs) while competitive products

[2] Although the Shapley Value was originally conceived as a potential solution to problems in cooperative game theory, it has also been applied to the problem of cost allocation. It has been shown, for example, that under certain conditions cost attribution resulting from application of the Shapley Value is identical to the attribution that would be expected to emerge from negotiations among department heads over how to share responsibility for covering the costs of shared resources. Alvin E. Roth and Robert E. Verrecchia, *The Shapley Value As Applied to Cost Allocation: A Reinterpretation*, JOURNAL OF ACCOUNTING RESEARCH, Vol. 17, No. 1 (Spring 1979).

come last (and thus are assigned only the least expensive variable costs).[3] UPS's petition and Dr. Neels report explain why these two proposals are consistent with the key insights of the Shapley Value.

UPS's cost attribution practices are also fully consistent with the Shapley Value. As discussed above, UPS attributes costs to products based on each product's share of the cost drivers that are appropriate for each pool of variable costs. As Dr. Neels explains in his report, the use of a Shapley Value-based cost allocation using the cost driver unit as the cost object is equivalent to assigning total variable costs (*i.e.*, the total area under the marginal cost curve) to products in proportion to their cost driver shares.[4] That is exactly what UPS does, and thus UPS's approach is equivalent to a cost allocation methodology based on the Shapley Value, regardless of whether UPS's management uses the Shapley Value terminology to describe what it is doing.

For the same reason, if the Postal Service took the logical step of using its existing distribution keys to attribute all of its variable costs to products (instead of just its marginal costs), that step too would be consistent with a Shapley Value approach.

[3] As UPS noted in its petition, if any ordering is to be applied it should be in *reverse* of the status quo. The Postal Service's private sector competitors must cover their more expensive variable costs without the benefit of market-dominant products, so parity requires that the Postal Service's competitive products also cover those more expensive variable costs. But another acceptable approach, which the Shapley Value supports, is not to use any ordering assumption at all.

[4] *See Report of Dr. Neels* at 22-29 (applying the Shapley Value and explaining that, if the cost driver unit is taken as the cost object and one considers all possible ways in which cost driver units can be ordered under the marginal cost curve, each cost driver unit has an equal probability of winding up at any specific location, and hence, each cost driver unit winds up being assigned the average per unit value of variable cost).

3. **On page 23 of The Neels Report, it states: "Application of the Shapley value as a cost allocation mechanism has been studied in a variety of different contexts…." Please provide an example of a regulated public utility or industry which directly applies any form of Shapley values in allocating common costs to products.**

The use of the Shapley Value has been expressly considered in a variety of regulatory contexts.[5] Notably, however, these examples just address situations in which the Shapley Value was *explicitly* recommended or used as a method of cost allocation. As discussed above, standard cost allocation practices that are routinely used by a variety of enterprises — including, for example, the one used by UPS — are fully consistent with the key conceptual insights arising out of the Shapley Value.

The Surface Transportation Board ("STB") provides an example of a regulator relying on cost measures computed in a manner consistent with the use of the Shapley Value without explicitly identifying it as such. Applying its congressional mandate, the STB determines whether the rate charged for a specific rail freight movement is subject

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[5] *See, e.g.,* ***Broadband/Telecommunications*** — Comments of the National Association of State Utility Consumer Advocates, Dkt. Nos. WC 10-90; WC 05-337 (Jul. 9, 2012), available at http://apps.fcc.gov/ecfs/document/view?id=7021984653; Interim Opinion Establishing a Permanent Rate For The High-Frequency Portion of The Loop, Decision 03-01-077, 2003 Cal. PUC LEXIS 80 (Cal. PUC 2003) ("*HFPL Interim Opinion*"); *Re: Investigation Into New England Telephone Company's Cost of Service and Rate Design*, Order, Dkt. No. 92-130, 1994 Me. PUC LEXIS 9 (Me. PUC 1994) ("*NET Order*").

Electricity Usage — Pawan Rathore, Ganga Agnihotri, Baseem Khan and Garima Naidu, *Transmission Usage and Cost Allocation Using Shapley Value and Tracing Method: A Comparison*, ELECTRICAL AND ELECTRONICS ENGINEERING: AN INTERNATIONAL JOURNAL (ELELIJ) Vol 3, No 3 (Aug. 2014); X. Tan and T.T. Lie, *Application of the Shapley Value on Transmission Cost Allocation in the Competitive Power Market Environment*, IEE PROCEEDINGS – GENERATION, TRANSMISSION, DISTRIBUTION, Vol. 149, No. 1, (Jan. 2002).

Water Resources Development — H.P. Young, N. Okada and T Hashimoto, *Cost Allocation in Water Resources Development*, WATER RESOURCES RESEARCH, Vol. 18, No. 3 (Jun. 1982).

to regulatory review based upon the ratio of price to average variable cost.[6] The core framework the STB employs to calculate variable cost is similar to the methodology set forth in UPS Proposal One and is consistent with applying the Shapley Value.

The STB's costing system utilizes an "activity approach" to estimate variable costs. The railroad's costs are divided up into several activities (akin to Postal Service cost components). Then, for each of those activities, STB costing procedures determine the portion of the activity's cost that is variable and the portion of the activity's cost that is fixed. Finally, *all* of the variable costs identified for each activity are assigned to specific shipments, in a manner akin to attributing variable costs to products, in proportion to the shipment's consumption of the relevant cost driver.

Notably the STB's costing procedures do not involve breaking up variable costs into the different categories of marginal and inframarginal in order to assign to products only the former and not the latter. Instead, the STB's methodology attributes all variable costs. As a result, consistent with the Shapley Value and UPS Proposal One, the STB ensures that all of the variable costs associated with a unit of production are assigned to the shipment associated with that unit of production.

The STB's approach of attributing all variable costs reflects considered analysis of how to implement its congressional mandate. As discussed by the STB's predecessor in this role, the Interstate Commerce Commission ("ICC"), this involves a recognition that attributable variable costs are not limited to marginal costs:

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[6] The average variable costs for the movement are calculated using the Uniform Rail Costing System ("URCS"). *See generally* Surface Transportation Board Report to Congress Regarding the URCS (2009), available at https://www.stb.dot.gov/stb/docs/URCS/URCS%20Report%205.27.10.pdf.

> In a variety of places, and most particularly in the sections governing the jurisdictional threshold and the apportioning of burdens of proof, the Interstate Commerce Act, as amended by the Staggers Act, uses the term "variable costs." The term is clearly intended to differentiate those costs that change with volume from the fixed costs that rail carriers might endure even in the absence of production. *In the standard economic lexicon, which Congress is presumed to have understood, variable cost is related to but differs from, marginal or incremental cost.* Variable cost measures the level of those costs that change with changes in volume; marginal cost measures the rate of change of the level of variable costs.

Adoption of the Uniform Railroad Costing System as a General Purpose Costing System for all Regulatory Costing Purposes, Interstate Commerce Commission Reports, 1989 ICC LEXIS 263 at *13-14 (Sep. 8, 1989) (emphasis added).

In rejecting arguments that cost attribution should be limited to marginal cost, the ICC considered the Causality Principle set forth by the former Railroad Accounting Principles Board:

> Costs shall only be attributed to cost objectives when a causal relationship exists (the cost would not have been incurred but for the requirements of the cost objective). A cost is the result of the use of resources. It can take many forms, depending on the purpose for which the cost information is needed.

Id. at *23, n.23. The ICC considered, and rejected, arguments that the Causality Principle described above "compels the use of cost elasticities and hence the development of marginal costs." *Id*. at *23. The ICC found, instead, that attribution of "[v]ariable costs [is] fully consistent with" the Causality Principle. *Id*. at *27.

This principle is somewhat similar to this Commission's own congressional mandate, which calls for attribution of "direct and indirect postal costs attributable to such product through reliably identified causal relationships." 39 U.S.C. § 3631. And,

as UPS has explained, this Commission should similarly find that attributing all variable costs using the distribution keys is consistent with this mandate.

As noted, the STB's approach to the treatment of variable costs is also consistent with the key conceptual insights of the Shapley Value, even though the STB does not appear to have labeled the approach as such. Like UPS Proposal One, *all* of the variable costs associated with railroad shipments are distributed *pro rata* to those shipments according to their consumption of cost driver units. And like UPS Proposal One, the cost assignments used by the STB reflect the core conceptual insight of Shapley and Roth that prices should reflect the results of a hypothetical negotiation among all of the railroad's shippers on how they will collectively cover the railroad's costs. Finally, STB costing procedures do not rely on any arbitrary ordering assumptions, but instead assign costs in an order-neutral manner.

4. **On page 28 of The Neels Report, it states, "[f]urthermore, the Shapley value results in a complete and exact allocation of inframarginal costs." Please provide all available supporting documentation that Shapley values result in accurate and precise allocations of costs.**

Cost allocations that are consistent with the Shapley Value are *complete* because they result in the assignment of all variable costs to products and are *exact* in the sense that they provide unique and well-defined results for how much cost should be allocated to each product. For a given cost structure and cost object, applying the Shapley Value results in a single answer to the question of how to allocate a given cost pool. The resulting cost allocation is objective and does not depend on arbitrary assumed orderings of products or divisions. Furthermore, when the cost object is either a unit of the cost driver or a dollar of product-specific cost, the Shapley Value results in a cost allocation that is independent of both product definitions and the boundaries between departments.

On page 20 of The Neels Report, Dr. Neels refers to the methodology developed by Dr. Charles McBride to calculate the Postal Service's inframarginal costs. For questions 5-7 please refer to the McBride Report.

5. **On page 6, the McBride Report states that "This approach was used by the Postal Service to calculate incremental costs before FY 2007, and, with serious reservations, we adopt the same approach for calculating inframarginal costs in this paper."**

   a. **Please explain (from your point of view) the "serious reservations" regarding the adopted approach.**

Dr. McBride's expression of "serious reservations" appears to reflect his concern that the Postal Service's assumptions regarding the variability and modeling of its different cost components are often not rigorously derived or transparently explained. Dr. McBride observed that the Postal Service often seemed to employ *ad hoc* or arbitrary methods "to decide which components would be designated as constant elasticity components and which would not." McBride Report at 8.

Dr. McBride expressed particular concern that the Postal Service classifies many costs as fixed without having a reliable economic basis for doing so. As he observes: "the numbers show that costs for many of these so-called fixed or near-fixed cost components declined even more than the system-wide total cost." *Id.* at 10. Note too that Dr. McBride's footnote stating his "serious reservations" appears at the end of the second bullet of his summary of the Postal Service's cost modeling approaches – a bullet that reads: "For non-constant elasticity components, Other costs are fixed." This further indicates that Dr. McBride's principal concern was with the Postal Service

classifying too many cost pools as wholly or nearly fixed without a reliable methodology or empirical basis for doing so.[7]

b. **Please discuss which of these reservations you consider valid, and why.**

UPS Proposal Two confirms that Dr. McBride's reservations are valid. For far too long, the Postal Service has treated many cost pools as wholly or nearly fixed without any empirically sound basis for doing so. As demonstrated by both Dr. McBride and Dr. Neels, many cost components the Postal Service currently classifies as fixed are clearly not fixed. UPS Proposal Two explains how this problem can be addressed both in the short and the long term.

c. **Please explain why you believe these reservations do not prevent this approach from being used for calculating inframarginal costs.**

Reservations about the soundness of the Postal Service's cost classification practices have no effect on the soundness of the analytical principle at stake in UPS Proposal One or the reliability of the methodology Dr. McBride employed for calculating inframarginal costs. These reservations simply indicate that inframarginal costs are likely understated because fixed costs are overstated.

Inframarginal costs are readily quantifiable and can be distributed to competitive products based on the distribution keys the Postal Service already uses. They are simply the variable (that is, non-fixed) costs in the Postal Service's various cost components *other than* the so-called "volume variable" (really, marginal) costs. Nothing

[7] The Commission asked the Postal Service to explain its methodology for classifying costs as fixed. In response, the Postal Service disclaimed any effort to determine which of its costs are fixed. *See Response of the USPS to Chairman's Information Request No. 2,* Response 4 (Nov. 20, 2015).

about the nature of inframarginal costs makes them any more difficult to calculate than other Postal Service costs. In fact, doing so is relatively straightforward: once the appropriate model for a cost component is identified, they are readily calculable, as Dr. McBride's work shows.

Of course, Postal Service cost classifications and models can change (and improve) over time. Such changes may affect the *amount* of variable (and inframarginal) costs in the cost model. For example, if a cost component previously regarded as fixed is shown to vary with volume and exhibit declining marginal costs, the *amount* of Postal Service variable (and inframarginal) costs will increase. But the ongoing need to improve Postal Service costing by no means implies that inframarginal costs are too amorphous or complex to calculate or to attribute to products. They are not. They are readily quantifiable and attributable in every Postal Service cost component in which they occur.

6. **On page 8, the McBride Report states that "We have serious reservations about the lack of a consistent approach as well as documentation for the criteria used by the Postal Service to decide which components would be designated as constant elasticity components and which would not." Please discuss how these concerns affect the accuracy of Dr. Neels' calculation of inframarginal costs.**

As discussed above, nothing about inframarginal costs make them any more difficult to calculate than any other type of Postal Service cost – including so-called "volume variable" or fixed costs. At any given point in time, based on the cost component models and variability classifications currently in place, calculating the inframarginal costs present in each cost component is a straightforward mathematical exercise. As noted, Dr. McBride's "serious reservations" simply indicate that current Postal Service costing models likely often *understate* the amount of variable costs (including inframarginal costs) because they overstate the amount of fixed costs.

7. **Please confirm that UPS and Dr. Neels consider constant elasticity an appropriate assumption for Postal Service costing. If not confirmed, please explain why it should be used in calculating inframarginal costs.**

UPS and Dr. Neels agree that the use of a constant elasticity cost curve is appropriate for many of the Postal Service's cost components, as many of those components tend to demonstrate behavior consistent with this type of cost curve.

A constant elasticity curve with decreasing marginal costs (*e.g.*, with elasticity less than one) is an appropriate model for capturing economies of scope and scale. When used in Postal Service costing, this model imposes the assumption that a given percent change in volume (*e.g.*, a 10% increase) will result in a certain lower percentage of additional costs (*e.g.*, a 5% increase) at any level of volume. This mathematical relationship clearly does not hold for components whose costs are entirely fixed, nor for components containing some fixed costs and in which marginal costs do not change with changes in volume. This mathematical relationship may also fail to hold exactly for those components in which marginal costs change with changes in volume.[8]

But the constant elasticity model does provide a reasonable approximation for many of the Postal Service's declining marginal cost components. As Dr. McBride explains, this model "is a simple one-parameter function that can reflect the economies of scale and scope inherent in many postal activities." *See* McBride Report at 5. In

[8] For example, in modeling city carrier costs the Postal Service employs a second-degree polynomial function. The coefficients of this function imply that over the relevant ranges of volume marginal costs generally decline with increases in volume, although not in the exact manner implied by the constant elasticity model. Nonetheless, UPS believes (as the Postal Service apparently does as well) that the constant elasticity model provides an acceptable and practical way of approximating the volume of inframarginal costs that exist in this cost component.

other words, the constant elasticity function is a simple, workable model that captures the essence of the Postal Service's economies of scale and scope in those cost components where such economies are present.

In any event, the precise shape of the marginal cost curve for variable cost components is irrelevant to the analytical principle at stake in UPS Proposal One. Even if a variable cost component like "City Carrier Delivery Activities" (component 47) had a marginal cost curve that differed from the constant elasticity curve, the entirety of the cost component is variable. Because the entirety of the cost component is variable, all costs under that curve can and should be attributed to individual products using the existing distribution keys.

Respectfully submitted,

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